THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON GROWTH OF IBERIAN NASE, *CHONDROSTOMA POLYLEPIS* (STEINDACHNER, 1865) IN THREE RESERVOIRS OF WESTERN SPAIN

by

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RÉSUMÉ. – L'objet de ce travail est l'étude des paramètres de la croissance du hotu ibérique, *Chondrostoma polylepis* Steindachner, dans trois retenues situées dans le bassin du Tage (Sud de l'Espagne). Les variations observées de ces paramètres ont été mises en relation avec quelques variables du milieu : profondeur moyenne (m.), teneur en chlorophylle *a* (mg/m^3) et temps de séjour de la masse d'eau dans la retenue (jours). Les auteurs discutent ensuite les résultats obtenus en les replaçant dans le cadre des processus écologiques généraux qui se déroulent dans les écosystèmes aquatiques.

SUMMARY. – We have studied the von Bertalanffy's growth parameters in *Chondrostoma polylepis* populations from three reservoirs of the Tagus River Basin (western Spain). The differences found are related to some environmental variables : mean depth (m.), Chlorophyll *a* concentration (mg/m^3) and the residence time of the water mass (days). The results are discussed in the ligth of the ecological processes that occur in aquatic ecosystems.

Key words. – *Chondrostoma polylepis*, growth, depth, primary production, Spain.

There are as many existing works about the influence of the many different environmental factors, biotics (Marciak, 1975 ; Rappaport and Sarig, 1979) and abiotics (Martin, 1966 ; Werner, 1979) on the growth of wild fish populations, as there are about biomass variations and fishery production of different lakes and reservoirs. Such influences have generated the appearance of predicted indices of fish production based on the environmental parameters that have the greatest correlation, such is the case of the morphoedaphic index (Ryder, 1965) which is widely used.

In this work a first aproximation is made regarding the relation between environmental variables and fish growth in Spanish reservoirs. Three Iberian nase populations , (*Chondrostoma polylepis* Steindachner) were studied , they belong to the same hydrographic basin but as they are separated by reservoir constructions, they had evolved according to the environmental characteristics of each reservoir.

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Cybium 1985, 9 (3) : 225-232.

In the comparative study the parameter used was the value of L_{oo} of von Bertalanffy's growth equation, because it is the most significant parameter of a fish population (Bernard, 1981). The environmental variables, reported by some authors as having the greatest influence on the fish population, were : the mean depth (surface/volume relationship) (Donald *et al.*, 1980) ; chlorophyll *a* concentration, as the indirect measurement of primary production (Henderson *et al.*, 1973) and time of residence of the water mass (Jenkins, 1976).

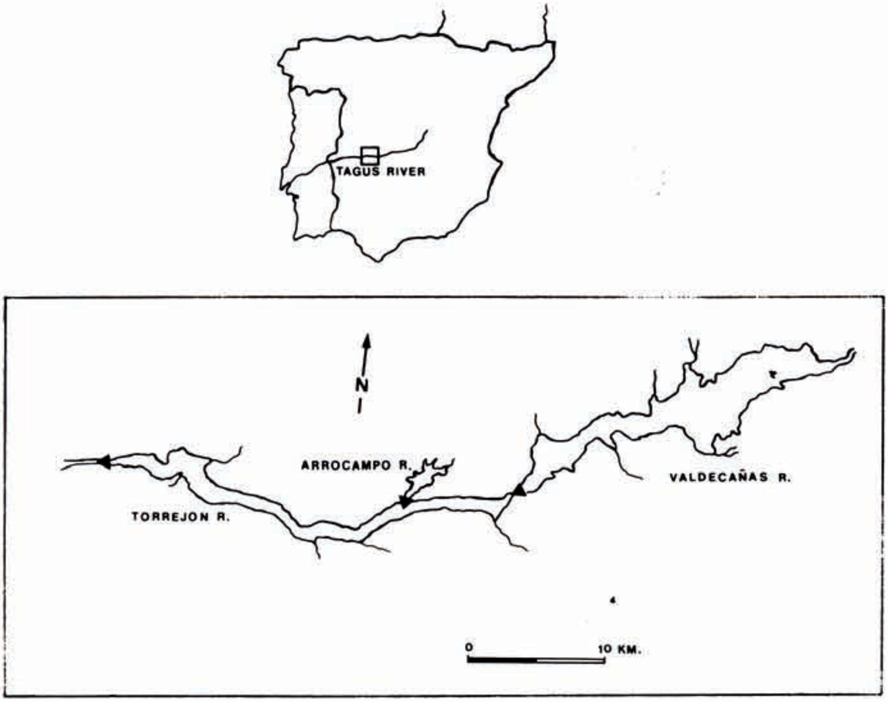

Fig. 1. – Geographic locations of the Valdecañas, Torrejón and Arrocampo reservoirs.

MATERIALS AND METHODS

The studied Iberian nase populations originated from the reservoirs of Valdecañas, Torrejón and Arrocampo, situated in the Tagus River basin (western Spain) (Fig. 1). The geology of the area is granitic with quarzites and predominantly siliceus materials, lacking in calcium. The climate is mediterranean with some continental influences. The three reservoirs have holomictyc-monomictyc characteristics (Hutchinson, 1957) and belong to the third group (eutrophic and little mineralized reservoirs) of Spanish reservoirs (Margalef *et al.*, 1976). The characteristics are shown in Table I.

During the period 1981-1984 monthly samplings took place in the three reservoirs using trammel and gill nets at different representative points of each re-

Table I. – Characteristics of the three reservoirs studied

	Year	Volume (hm^3)	Surface (ha)	Mean Depth (m)	Residence Time (day)	Chlorophyll *a* (mg/m^3)
Valdecañas	1965	1446,0	7300	19,8	90	9,17*
Torrejón	1967	178,0	1260	14,1	20	32,30*
Arrocampo	1977	35,5	770	4,6	300	54,30**

* Margalef *et al.*, 1976.

** Central Nuclear de Almaraz, 1973.

servoir. For the growth study, out of the total of fish caught, 80 specimens of the Valdecañas reservoir, 100 of the Torrejon reservoir and 100 of the Arrocampo reservoir were taken, and amongst the specimens every age class was represented.

The individuals were frozen in the field and taken to the laboratory where the different growth parameters were studied. On each specimen the following methodology was used : a) *age* : scales (Nikolsky, 1963 ; Mann, 1974), Cassie and Petersen's methods (Larrañeta, 1967) ; b) *von Bertalanffy's growth equation* : estimating the value of L_{∞} and K (Ricker, 1975) and t_0 (Gulland, 1967).

In total, ten measurements of each individual were taken (Fig. 2) : head length (HL), dorsal fin length (DF), anal fin length (AF) maximum body height (MBH), anus to caudal fin length (AC), maximum body width (MBW), interorbital distance (ID), weight (W), standard length (STL) and pre-buccal distance (PB).

The data matrix of the three reservoirs was examined using Principal Components Analysis (PCA). This method has been used to detect groups of individuals based on morphometric variables (Kux and Libosvarsky, 1981).

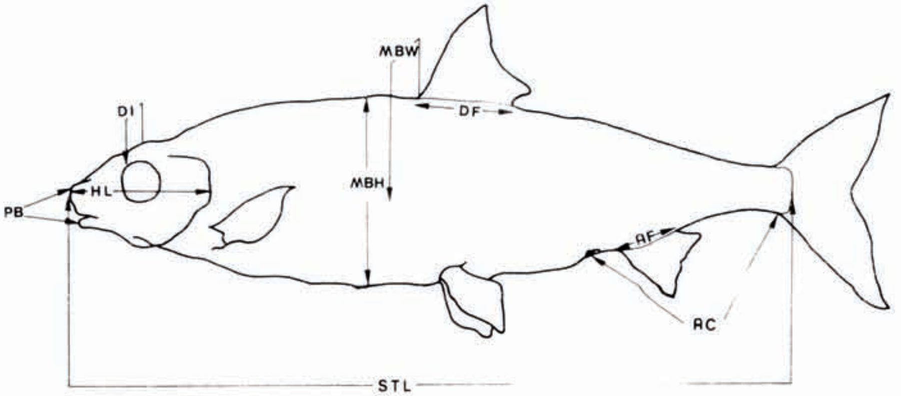

Fig. 2. – Morphometric measurements taken of each individual.

RESULTS

The population of the Valdecañas reservoir showed an age structure formed by five classes (0+ to IV+), the average length of which (integrating the three methods used) can be seen in Table II. The values of L_{oo}, K and t_o were 314.0 mm, 0,221 and –1,565, respectively.

In the population of the Torrejon reservoir seven age classes were found (0+ to VI+) (see Table II). The values of L_{oo}, K and t_o were 349,9 mm 0,258 and –0,302, respectively.

The age structure of the Arrocampo's population was formed by five classes (0+ to IV+) (Table II). The values of L_{oo}, K and t_o were 448,5 mm 0,230 and –1,320, respectively.

The Principal Components analysis of the morphometric data matrix was very efficient because the first component absorbed 71,2 % of the variance. The correlation matrix between the morphometric variables (Table IV) showed high coefficients between them. The distribution of individuals from the three reservoirs shows a size gradient (Fig. 3); the 0+ age class of all the reservoirs is grouped on the negative extreme of the first component, while the other age classes have a diffused distribution. It was observed that there was a segregation between the different reservoirs for the same age class and that this phenomenon reached its maximum degree on the positive extreme, on which only the specimens of the fourth age class of the Arrocampo reservoir appear (greatest size found).

Table II. – Average standard length (in mm) for each age class

Age class	0+	I+	II+	III+	IV+	V+	VI+
Valdecañas	92,2	166,5	211,0	264,3	271,6	–	–
Torrejón	109,6	176,0	226,8	250,0	273,5	295,5	310,0
Arrocampo	111,5	195,4	246,4	271,4	317,5	–	–

Table III. – Von Bertalanffy's growth equation parameters

	L_{∞}	K	t_0
Valdecañas	314,0	0,221	–1,565
Torrejón	349,0	0,298	–0,302
Arrocampo	448,5	0,230	–1,320

DISCUSSION

Examining the results obtained, it is certainly possible to observe differences between the three populations studied. These differences shall be discussed in the light of environmental factors.

The correlation coefficients between L_{oo} of each population and the three

Table IV. – Pearson Product-Moment correlation coefficients matrices for ten morphometric characters of Iberian nase from all the reservoirs studied

	HL	DF	AF	MBH	AC	MBW	ID	W	STL	PB
HL	1,00									
DF	0,86	1,00								
AF	0,85	0,87	1,00							
MBH	0,89	0,85	0,85	1,00						
AC	0,82	0,78	0,79	0,72	1,00					
MBW	0,85	0,86	0,89	0,87	0,64	1,00				
ID	0,93	0,83	0,87	0,89	0,77	0,87	1,00			
W	0,84	0,82	0,80	0,88	0,69	0,85	0,83	1,00		
STL	0,90	0,84	0,87	0,88	0,72	0,87	0,91	0,85	1,00	
PD	0,73	0,67	0,65	0,62	0,81	0,65	0,66	0,62	0,70	1,00

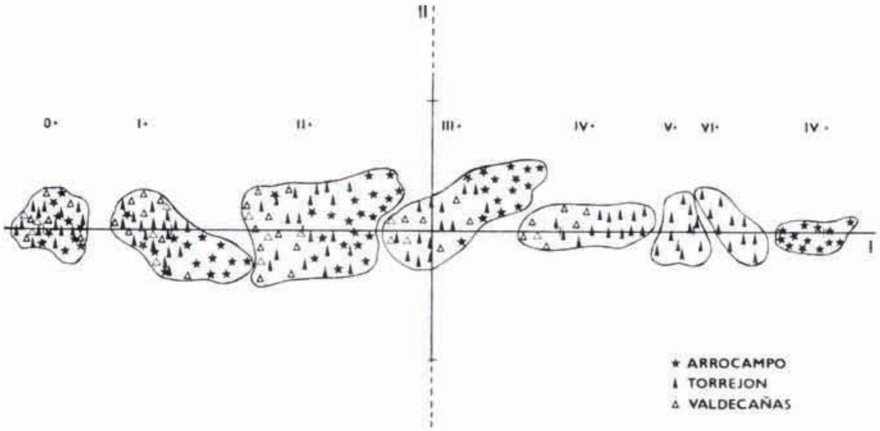

Fig. 3. – Principal Component Analysis of ten variables - in *Chondrostoma polylepis* from Valdecañas R., - Torrejón R. and Arrocampo R.

environmental variables show high values. However, given the fact that only three reservoirs were studied we cannot give a mathematically correct interpretation. The correlation coefficients between L_{oo} and the mean depth was $r = -0.98$ (significant at 5 % level), with the chlorophyll *a* concentration it was $r = 0.96$ (significant at 5 % level) and with the residence time it was $r = 0.84$ (not significant at 5 % level).

The regression lines between L_{oo} and the mean depth, and L_{oo} and the Chlorophyll *a* concentration show a better fit that the line between L_{oo} and the residence time (Fig. 4).

This relationship between the biological aspects of the fish populations and some environmental factors expresses the complex ecological processes that occur in aquatic ecosystems. The mean depth of the reservoir determines its primary production because in shallow water the euphotic zone can reach the bottom and allow not only the photosynthesis in all the water column, but also the development of phytobenthos (complement of planktonic primary production) and also the structuration of the benthonic community (Ryder *et al.*, 1974). Owing to this the total primary production of the reservoir, when the nutrient concentration is similar, will be greater in shallow water than in deep water. All the synthesized organic

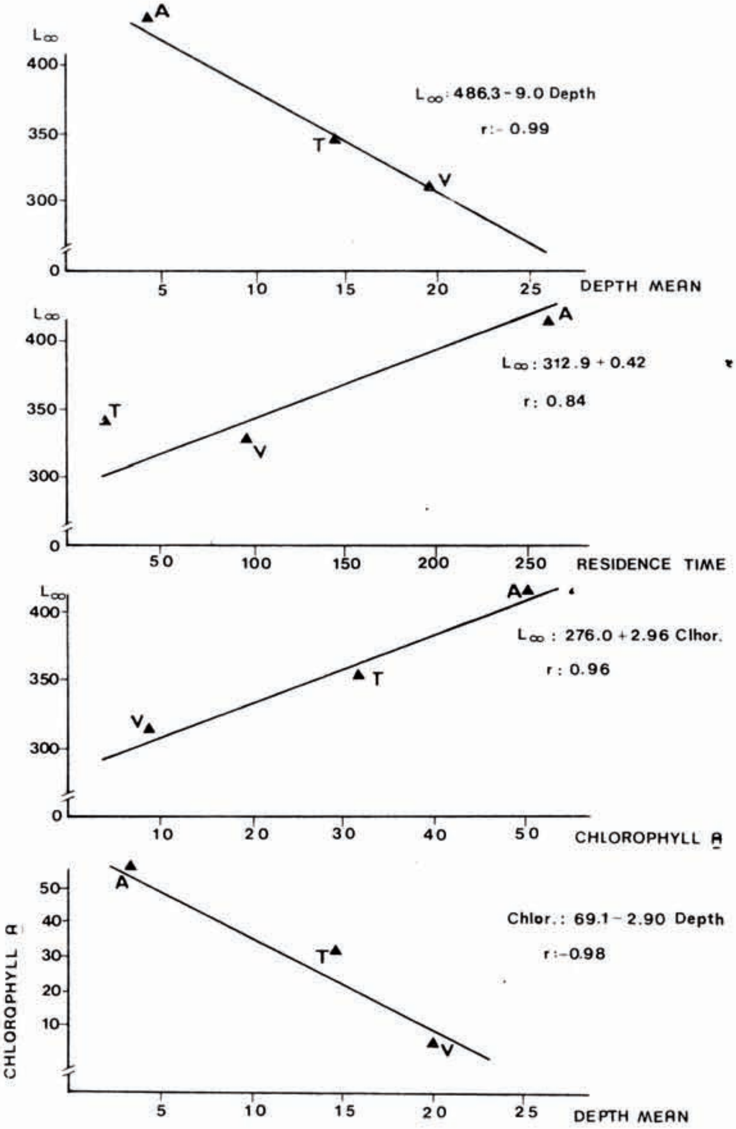

Fig. 4. – Regression line between L_∞ and the environmental variables studied. A : Arrocampo R.; T : Torrejón R.; V : Valdecañas R.

matter will flow through the trophic chain of the ecosystem and will maintain higher production in the superior trophic levels, increasing the population and the individual growth rate (in absence of competence processes).

An other environmental variable that influences the structure of the ecosystems in eutrophic reservoirs is the residence time of the water (Margalef, 1983). A high residence time allows temporal structuration (ecological sucession) of the phytoplanktonic community and, as such, a better use of the nutrient elements available, as the nutrients are more easily transferred to higher trophic levels (principally fishes, but depending on their feeding habits). Low residence times prevent the above mentioned structuration ; the nutrients, released from the sediments during the mixing period, accumulate on the bottom and the energy is canalized by detritic way.

In Spanish reservoirs, due the way in which the water is used (electric power, irrigation, supply, etc.), low residence times are associated to strong variation of the levels. These variations impede the development of the littoral benthos and shore vegetation (a complement of the total primary production and very important reproduction area for the ichthyofauna).

Finally, according to our results, we believe that it is possible to use the mean depth, primary production and residence time of the water mass in comparative studies of fish populations. It is hoped that these and other environmental variables will make their way also in the evaluation of fish biomass and fishery production of the Spanish reservoirs.

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